



[7590-01-P]

NUCLEAR REGULATORY COMMISSION

[Docket Nos. STN 50-456, STN 50-457, STN 50-454 and STN 50-455; NRC-2016-0124]

Exelon Generation Company, LLC;

Braidwood Station, Units 1 and 2, and Byron Station, Unit Nos. 1 and 2

AGENCY: Nuclear Regulatory Commission.

ACTION: Exemption; issuance.

SUMMARY: The U.S. Nuclear Regulatory Commission (NRC) is issuing an exemption in response to a February 23, 2016, request from Exelon Generation Company, LLC, requesting an exemption to allow use of a different fuel rod cladding material (Optimized ZIRLO™).

ADDRESSES: Please refer to Docket ID **NRC-2016-0124** when contacting the NRC about the availability of information regarding this document. You may obtain publicly-available information related to this document using any of the following methods:

- **Federal Rulemaking Web Site:** Go to <http://www.regulations.gov> and search for Docket ID **NRC-2016-0124**. Address questions about NRC dockets to Carol Gallagher; telephone: 301-415-3463; e-mail: Carol.Gallagher@nrc.gov. For technical questions, contact the individual listed in the FOR FURTHER INFORMATION CONTACT section of this document.

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- **NRC's PDR:** You may examine and purchase copies of public documents at the NRC's PDR, Room O1-F21, One White Flint North, 11555 Rockville Pike, Rockville, Maryland 20852.

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SUPPLEMENTARY INFORMATION:

I. Background

Exelon Generation Company, LLC (Exelon or the licensee) is the holder of renewed Facility Operating License Nos. STN 50-456, STN 50-457, STN 50-454 and STN 50-455, which authorize operation of the Braidwood Station (Braidwood), Units 1 and 2, and the Byron Station (Byron) Unit Nos. 1 and 2, respectively. The license provides, among other things, that the facility is subject to all rules, regulations, and orders of the NRC now or hereafter in effect.

The Braidwood facility consists of two pressurized-water reactors located in Will County in Illinois and the Byron facility consists of two pressurized-water reactors located in Ogle County in Illinois.

II. Request/Action

Pursuant to section 50.12 of title 10 of the *Code of Federal Regulations* (10 CFR), “Specific exemptions,” the licensee has, by letter dated February 23, 2016 (ADAMS Accession No. ML16055A149), requested an exemption from 10 CFR 50.46, “Acceptance criteria for emergency core cooling systems [ECCS] for light-water nuclear power reactors,” and 10 CFR part 50, appendix K, “ECCS Evaluation Models,” to allow the use of fuel rod cladding with Optimized ZIRLO™ alloy for future reload applications. The regulations in 10 CFR 50.46 contain acceptance criteria for the ECCS for reactors fueled with zircaloy or ZIRLO™ fuel rod cladding material. In addition, paragraph I.A.5 of appendix K to 10 CFR part 50 requires that the Baker-Just equation be used to predict the rates of energy release, hydrogen concentration, and cladding oxidation from the metal/water reaction. The Baker-Just equation assumes the use of a zirconium alloy, which is a material different from Optimized ZIRLO™. Thus, the strict application of these regulations does not permit the use of fuel rod cladding material other than zircaloy or ZIRLO™. Because the material specifications of Optimized ZIRLO™ differ from the specifications for zircaloy or ZIRLO™, and the regulations specify a cladding material other than Optimized ZIRLO™, a plant-specific exemption is required to allow the use of, and application of these regulations to, Optimized ZIRLO™ at Braidwood and Byron Stations.

The exemption request relates solely to the cladding material specified in these regulations (i.e., fuel rods with zircaloy or ZIRLO™ cladding material). This exemption would allow application of the acceptance criteria of 10 CFR 50.46 and 10 CFR part 50, appendix K, to fuel assembly designs using Optimized ZIRLO™ fuel rod cladding material. In its letter dated February 23, 2016, the licensee indicated that it was not seeking an exemption from the acceptance and analytical criteria of these regulations. The intent of the request is to allow the use of the criteria set forth in these regulations for the use of Optimized ZIRLO™ fuel rod cladding material at Braidwood and Byron Stations.

III. Discussion

Pursuant to 10 CFR 50.12, the Commission may, upon application by any interested person or upon its own initiative, grant exemptions from the requirements of 10 CFR part 50 when: (1) the exemptions are authorized by law, will not present an undue risk to public health or safety, and are consistent with the common defense and security; and (2) when special circumstances are present. Under 10 CFR 50.12(a)(2)(ii), special circumstances include, among other things, when application of the specific regulation in the particular circumstance would not serve, or is not necessary to achieve, the underlying purpose of the rule.

Special Circumstances

Special circumstances, in accordance with 10 CFR 50.12(a)(2)(ii), are present whenever application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the rule. The underlying purpose of 10 CFR 50.46 and appendix K to 10 CFR part 50 is to establish acceptance criteria for ECCS performance to provide reasonable assurance of safety in the event of a loss-of-coolant accident (LOCA). Although the regulations in 10 CFR 50.46 and appendix K are not expressly applicable to Optimized ZIRLO™, the evaluations described in the following sections of this exemption show that the purpose of the regulations are met by this exemption in that, subject to certain conditions, the acceptance criteria are valid for Optimized ZIRLO™ fuel cladding material, Optimized ZIRLO™ would maintain better post-quench ductility, and the Baker-Just correlation conservatively bounds LOCA scenario metal-water reaction rates and is applicable to Optimized ZIRLO™. Thus, a strict application of the rule (which would preclude the applicability of ECCS performance acceptance criteria to, and the use of, Optimized ZIRLO™ fuel cladding material) is not necessary to achieve the underlying purposes of 10 CFR 50.46 and appendix K to 10 CFR

part 50. The purpose of these regulations is achieved through application of the specific requirements to use the Optimized ZIRLO™ fuel rod cladding material. Therefore, the special circumstances required by 10 CFR 50.12(a)(2)(ii) for the granting of an exemption exist.

Authorized by Law

This exemption would allow the use of Optimized ZIRLO™ fuel rod cladding material for future reload operations at Braidwood and Byron Stations. As stated above, 10 CFR 50.12 allows the NRC to grant exemptions from the requirements of 10 CFR part 50 provided that special circumstances are present. As described above, the NRC staff has determined that special circumstances exist to grant the requested exemption. In addition, granting the exemption will not result in a violation of the Atomic Energy Act of 1954, as amended, or the Commission's regulations. Therefore, the exemption is authorized by law.

No Undue Risk to Public Health and Safety

Section 10 CFR 50.46 requires that each boiling or pressurized light-water nuclear power reactor fueled with uranium dioxide pellets within cylindrical zircaloy or ZIRLO™ cladding must be provided with an ECCS that must be designed so that its calculated cooling performance following a postulated LOCA conforms to the criteria set forth in paragraph (b) of section 10 CFR 50.46. The underlying purpose of 10 CFR 50.46 is to establish acceptance criteria for adequate ECCS performance. As previously documented in the NRC staff's safety evaluation dated June 10, 2005 (ADAMS Accession No. ML051670395), of topical reports submitted by Westinghouse Electric Company, LLC (Westinghouse), and subject to compliance with the specific conditions of approval established therein, the NRC staff found that Westinghouse demonstrated the applicability of these ECCS acceptance criteria to Optimized ZIRLO™. Ring compression tests performed by Westinghouse on Optimized ZIRLO™ (see

WCAP-14342-A & CENPD-404-NP-A at ADAMS Accession No. ML062080569) demonstrate an acceptable retention of post-quench ductility up to 10 CFR 50.46 limits of 2,200 degrees Fahrenheit and 17 percent equivalent clad reacted. Furthermore, the NRC staff has concluded that oxidation measurements provided by the licensee in letter LTR-NRC-07-58 from Westinghouse to the NRC, "SER Compliance with WCAP-12610-P-A & CENPD-404-P-A, Addendum 1-A, 'Optimized ZIRLOTM,'" dated November 6, 2007 (public version located at ADAMS Accession No. ML073130560), illustrate that oxide thickness and associated hydrogen pickup for Optimized ZIRLO™ at any given burnup would be less than both zircaloy-4 and ZIRLO™. Hence, the NRC staff concludes that Optimized ZIRLO™ would be expected to maintain better post-quench ductility than ZIRLO™. This finding is further supported by an ongoing LOCA research program at Argonne National Laboratory, which has identified a strong correlation between cladding hydrogen content (caused by in-service corrosion) and postquench ductility.

Westinghouse, in letters dated January 4, 2007 (ADAMS Accession Nos. ML070100385 and ML070100388), November 6, 2007 (ADAMS Accession Nos. ML073130556 and ML073130560), December 30, 2008 (ADAMS Accession Nos. ML080390451 and ML080390452), February 5, 2009 (ADAMS Accession Nos. ML090080380 and ML090080381), July 26, 2010 (ADAMS Accession Nos. ML102140213 and ML102140214), February 25, 2013 (ADAMS Accession Nos. ML13070A188 and ML13070A189), and February 9, 2015 (ADAMS Accession Nos. ML15051A427 and ML15051A429), provided information that confirmed the models' applicability for burnups up to 62 GWD/MTU for Westinghouse fuels.

In addition, the provisions of 10 CFR 50.46 require the licensee to periodically evaluate the performance of the ECCS, using currently approved LOCA models and methods, to ensure that the fuel rods will continue to satisfy 10 CFR 50.46 acceptance criteria. In its letter dated February 23, 2016, the licensee stated that it will evaluate fuel assemblies using Optimized ZIRLO™ fuel rod cladding material using NRC-approved methods and models to address the

use of Optimized ZIRLO™ fuel rod cladding. The NRC staff concludes that granting the exemption to allow the licensee to use Optimized ZIRLO™ fuel rod cladding material and apply 10 CFR 50.46 criteria would not diminish this requirement of periodic evaluation of ECCS performance. Thus, the underlying purpose of the rule to maintain post-quench ductility in the fuel cladding material through ECCS performance criteria will continue to be achieved for Braidwood and Byron Stations.

Paragraph I.A.5 of Appendix K to 10 CFR part 50 states that the rates of energy release, hydrogen concentration, and cladding oxidation from the metal-water reaction shall be calculated using the Baker-Just equation. Since the Baker-Just equation presumes the use of zircaloy clad fuel, strict application of this provision of the rule would not permit use of the equation for Optimized ZIRLO™ fuel rod cladding material for determining acceptable fuel performance. The underlying purpose of this regulation, however, is to ensure that analyses of fuel response to LOCAs are conservatively calculated. In its evaluation of the approved topical reports, the NRC staff previously found that metal-water reaction tests performed by Westinghouse on Optimized ZIRLO™ (see Appendix B of WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A) demonstrate conservative reaction rates relative to the Baker-Just equation, and that the Baker-Just equation conservatively bounds post-LOCA scenarios of, and applicable to, Optimized ZIRLO™ fuel rod cladding. Thus, the NRC staff determined that the strict application of Appendix K, Paragraph I.A.5 (which would preclude its applicability to, and the use of, Optimized ZIRLO™) is not necessary to achieve the underlying purpose of the rule in these circumstances. Since these evaluations demonstrate that the underlying purpose of the rule will be met, there will be no undue risk to the public health and safety.

Consistent with the Common Defense and Security

The licensee's exemption request is to allow the application of an improved fuel rod cladding material to the regulations in 10 CFR 50.46 and paragraph I.A.5 of appendix K to 10 CFR part 50. In its letter dated February 23, 2016, the licensee stated that all the requirements and acceptance criteria will be maintained. The licensee is required to handle and control special nuclear material in these assemblies in accordance with its approved procedures. This change to reactor core internals is adequately controlled by NRC requirements and is not related to security issues. Therefore, the NRC staff determined that this exemption does not impact, and thus is consistent with, the common defense and security.

Environmental Considerations

The NRC staff determined that the exemption discussed herein meets the eligibility criteria for the categorical exclusion set forth in 10 CFR 51.22(c)(9) because it is related to a requirement concerning the installation or use of a facility component located within the restricted area, as defined in 10 CFR part 20, and issuance of this exemption involves: (i) no significant hazards consideration, (ii) no significant change in the types or a significant increase in the amounts of any effluents that may be released offsite, and (iii) no significant increase in individual or cumulative occupational radiation exposure. Therefore, in accordance with 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the NRC's consideration of this exemption request. The basis for the NRC staff's determination is discussed as follows with an evaluation against each of the requirements in 10 CFR 51.22(c)(9)(i) through (iii).

Requirements in 10 CFR 51.22(c)(9)(i)

The NRC staff evaluated whether the exemption involves no significant hazards consideration using the standards described in 10 CFR 50.92(c), as presented below:

1. Does the proposed exemption involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No.

The proposed exemption would allow the use of Optimized ZIRLO™ fuel rod cladding material in the reactors. The NRC approved topical report WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A “Optimized ZIRLO™,” prepared by Westinghouse, addresses Optimized ZIRLO™ and demonstrates that Optimized ZIRLO™ has essentially the same properties as currently licensed ZIRLO®. The fuel cladding itself is not an accident initiator and does not affect accident probability. Use of Optimized ZIRLO™ fuel cladding material will continue to meet all 10 CFR 50.46 acceptance criteria and, therefore, will not increase the consequences of an accident.

Therefore, the proposed exemption does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed exemption create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No.

The use of Optimized ZIRLO™ fuel rod cladding material will not result in changes in the operation or configuration of the facility. Topical Reports WCAP-12610-P-A and CENPD-404-PA demonstrated that the material properties of Optimized ZIRLO™ are similar to those of standard ZIRLO®. Therefore, Optimized ZIRLO™ fuel rod cladding material will perform similarly to those fabricated from standard ZIRLO®, thus precluding the possibility of the fuel cladding becoming an accident initiator and causing a new or different type of accident.

Therefore, the proposed exemption does not create the possibility of a new or different kind of accident from any previously evaluated.

3. Does the proposed exemption involve a significant reduction in a margin of safety?

Response: No.

The proposed exemption will not involve a significant reduction in the margin of safety because it has been demonstrated that the material properties of the Optimized ZIRLO™ are not significantly different from those of standard ZIRLO®. Optimized ZIRLO™ is expected to perform similarly to standard ZIRLO® for all normal operating and accident scenarios, including both LOCA and non-LOCA scenarios. For LOCA scenarios, where the slight difference in Optimized ZIRLO™ material properties relative to standard ZIRLO® could have some impact on the overall accident scenario, plant-specific LOCA analyses using Optimized ZIRLO™ properties will demonstrate that the acceptance criteria of 10 CFR 50.46 have been satisfied.

Therefore, the proposed exemption does not involve a significant reduction in a margin of safety.

Based on the above evaluation of the standards set forth in 10 CFR 50.92(c), the NRC staff concludes that the proposed exemption involves no significant hazards consideration. Accordingly, the requirements of 10 CFR 51.22(c)(9)(i) are met.

Requirements in 10 CFR 51.22(c)(9)(ii)

The proposed exemption would allow the use of Optimized ZIRLO™ fuel rod cladding material in the reactors. Optimized ZIRLO™ has essentially the same material properties and performance characteristics as the currently licensed ZIRLO® cladding. Thus, the use of Optimized ZIRLO™ fuel rod cladding material will not significantly change the types of effluents that may be released offsite, or significantly increase the amount of effluents that may be released offsite. Therefore, the requirements of 10 CFR 51.22(c)(9)(ii) are met.

Requirements in 10 CFR 51.22(c)(9)(iii)

The proposed exemption would allow the use of Optimized ZIRLO™ fuel rod cladding material in the reactors. Optimized ZIRLO™ has essentially the same material properties and performance characteristics as the currently licensed ZIRLO® cladding. Thus, the use of Optimized ZIRLO™ fuel rod cladding material will not significantly increase individual occupational radiation exposure, or significantly increase cumulative occupational radiation exposure. Therefore, the requirements of 10 CFR 51.22(c)(9)(iii) are met.

Conclusion

Based on the above, the NRC staff concludes that the proposed exemption meets the eligibility criteria for the categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, in accordance with 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the NRC's proposed issuance of this exemption.

IV. Conclusions

Accordingly, the Commission has determined that, pursuant to 10 CFR 50.12, the exemption is authorized by law, will not present an undue risk to the public health and safety, and is consistent with the common defense and security. Also, special circumstances pursuant to 10 CFR 50.12(a)(2)(ii) are present. Therefore, the Commission hereby grants Exelon an exemption from the requirements of 10 CFR 50.46 and appendix K to 10 CFR part 50, to allow the application of those criteria to, and the use of, Optimized ZIRLO™ fuel rod cladding material at the Braidwood Station, Units 1 and 2, and Byron Station Unit Nos. 1 and 2.

This exemption is effective upon issuance.

Dated at Rockville, Maryland, this 20th day of June 2016.

For the Nuclear Regulatory Commission.

Anne T. Boland, Director
Division of Operating Reactor Licensing
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